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(54) **Process for brazing metals**

(57) In a metal brazing process, particularly suitable for forming composite bottoms of kitchen utensils, use is made of a solder-flux composite in which the flux is contained in a plurality of cavities formed on at least one face provided on the solder.

In one embodiment, a strip of solder is formed by passage between a relief-surfaced roller and a roller covered with a deformable covering, with indentations and corresponding projections on respective opposite faces. The arrangement is such that the indentations formed on one face and the cavities formed between the projections on the other face retain a substantially identical quantity of flux. The contours of these indentations are preferably regular rows of squares, rhombuses or triangles.

Chemical or electro-chemical engraving may also be used to form the cavities.

Brazing using induction heating is referred to.

GB 2 047 150 A

SPECIFICATION

Process for brazing metals.

The present invention relates to a process for brazing metals and, in particular, to an improved process for brazing metals which is particularly suitable for brazing, with flux, the composition bottoms of kitchen utensils.

It is known to produce joints between metals either of the same or of a different type by means of a filler metal in the presence of a solid scouring flux (the general term "metal" is defined herein as including pure metals and metal alloys). It is thus possible to solder, for example, aluminium and stainless steel, copper or aluminium, or copper and stainless steel. Some filler metal in the form of a wire which is coated with flux or provided with a flux-filled channel or in the form of a powdered metal mixed with some flux is used for this purpose. The chemical compositions of the solders and fluxes are known to the skilled man, as are the heating processes permitting assembly by soldering (for example, resistance, furnace or blow-pipe heating).

French Patent No. 2,391,803 describes a process for brazing metals which is particularly suitable for both individual and mass production of bottoms for kitchen utensils composed of several metals as well as for the electrical connections between conducting metals. Excellent thermal conductivity has to be produced in the first case and excellent electrical conductivity between the various elements assembled by brasing in the second case, this not always being permitted by processes using powdered solders.

The process according to French Patent No. 2,391,803 is characterised by the use of a solder which has previously been coated with an even adhering layer of flux which is cut to a shape and dimensions adapted to the shape and size of the elements to be assembled.

The solder can be present in the form of a thin homogeneous strip, but also in the form of a thin strip with empty spaces between the elements thereof in which the flux will lodge, such as a cloth, a grid, some perforated or expanded metal the surface of which has optionally been treated to improve the adhesion of the flux. It is also possible for one of the parts to be assembled to have previously been provided with a layer of solder on one of its faces or on both faces by a conventional process such as rolling and for the layer of solder itself to be covered with a suitable layer of flux with a view to subsequent assembly. In all cases, the flux is deposited by a conventional method, for example by immersion into a suspension of flux in a liquid (for example, water with various additives to ensure suspension or an organic liquid), by sprinkling or spraying the suspension, for example, using a gun. It is also possible to immerse the solder in a bath of molten flux. If the solder has the form of a thin strip, it is possible to circulate the strip in a furnace which is maintained at a regulated temperature and contains and a thin film of very adhesive flux remains fixed on the two faces of the strip in which blanks of the desired shape and size can be cut immediately. The same applies if the solder is in the form of a cloth, a grid or perforated or expanded metal. To assist the adhesion of the flux, the solder can be subjected to various surface treatment such as heating to a moderate temperature, degreasing and brushing.

However, the implementation of this process as just described gives rise to a certain number of disadvantages.

On the one hand, grids or expanded metal made of soldering alloy are not readily available and it would be inconvenient to manufacture them especially. Moreover, the adhesion of the flux which is liquid or is dissolved between the meshes of the grid is associated with surface tension phenomena which are not always controlled perfectly and which can give rise to irregular adhesion. On the other hand, in the case of the thin strip, the thin strip of solder and the flux melt almost simultaneously at the moment of brazing, and the liquid flux tends to form large areas which, after cooling, will form unsoldered zones in which the transmission of heat between the various layers constituting the bottom of the utensil will be interrupted. Furthermore, the mechanical strength of the joint produced in this way will be diminished.

The present invention obviates these disadvantages.

Thus, according to the present invention, a process for brazing metals is provided which allows the distribution and adhesion of the flux on the strip of solder to be improved by engraving the strip on at least one of its two faces so as to reveal small cavities adapted to receive the flux.

From among the various methods of forming these cavities, one of the most effective and the one which is most suitable for industria. application involves passing the strip either between a driven engraving roller and a wild roller the surface coating of which is capable of elastic deformation such as cardboard, rubber or certain flexible plastics or between two engraving rollers which are driven synchronously without the possibility of sliding.

In the first embodiment, the engraving roller in relief forms regular cavities on the strip. These cavities can be of very different shapes, but it has been found that the best results are obtained if they have regular geometric shapes and their contour is an equilateral or isosceles triangle, a square or rhombus with a side or diagonal dimension of the order of from 0.5 to 5 mm and, preferably, between 1 and 2 mm, and a maximum depth of from a few hundreths to a few tenths of a millimetre.

These regular geometric shapes can be obtained very easily by simple and inexpensive mechanical means, and strips of solder made of aluminium-silicon alloys are currently available with silicon contents ranging from 5 to 20% for example AS 13 (containing 13% silicon) in thicknesses of a few tenths of a millimetre, thus permitting reduced production costs.

cavities between them in which the flux will also lodge. To ensure that there is a substantially equal distribution of flux on each face, it is desirable for the total volume of the cavities on each face to be approximately equivalent. This result can be achieved if the reliefs on the engraving roller are in the form of rhombuses or squares which are aligned both along their large diagonal and their small diagonal and are substantially tangential through their peak. Rows of equilateral triangles could also be considered.

In the second embodiment, the two engraving rollers contain identical engraving which is also formed by rows of regular quadrilaterals, squares or rhombuses, along their two diagonals or of isosceles or equilateral triangles aligned along one of their height and their base, one of the rollers being offset by half an engraving step, that is to say half a diagonal, relative to the other, both in the longitudinal direction and in the transverse direction. This offsetting has to be kept constant and the rotation kept synchronous without slipping, by any known means. Strict symmetry between the cavities formed on each face is thus obtained although simplicity is sacrificed.

Another method of forming the cavities to retain the flux involves chemical or electrochemical engraving on one or both faces, by regulating the depth of attack in a known manner depending on the concentration, the temperature and the duration of action of the attacking reagent. The strips of solder engraved in this way can be covered with flux by any of the methods described above.

Due to the perfect adhesion of the flux, it is possible either previously to cover the strip with flux then to cut the blanks to the shapes and sizes corresponding to the shapes and sizes of the elements to be assembled or previously to cut the blanks in the engraved strip and then to cover them with flux, as desired and depending on the conditions employed by each user.

The implementation of the improvement forming the subject of the present application very substantially improves the adhesion of the flux on the strip of solder, and this allows the blanks to be conveyed, stored and handled without any danger of a local lack of flux at the moment of soldering. Moreover, due to the regular distribution of the flux in the interstices, there is no longer any danger of finding large unsoldered areas which are isolated by solidified flux when carrying out wrenching tests on the soldered articles. On the contrary, the solidified flux is distributed very regularly. This results in regular distribution of the soldered areas thereby ensuring homogeneous thermal conductivity over the entire surface. However, since a proportion of the flux remains trapped between the brazed parts, and in order to prevent corrosion in the areas where the flux appears at the surface (on the edge of the assembly) it is preferable to use a non-corrosive flux and, in particular, to avoid the use of flux based on chlorides or alkaline flourides.

The invention is illustrated by the following Example

Example

The object was to manufacture kitchen utensils having a stainless steel body and a bottom comprising three layers, the internal layer of stainless steel forming part of the body, the intermediate layer composed of an aluminium disc and the external layer composed of a disc of stainless steel. To this end a blank of solder composed of an aluminium silicon alloy containing about 13% of silicon was interposed between the aluminium disc on the one hand and the two layers of stainless steel on the other hand.

This blank was obtained by passing a 0.040 mm thick rolled strip between a driven engraving cylinder and a wild cylinder covered with thick cardboard. The engraving consisted of rhombuses having a large diagonal of 2 mm and a small diagonal of 1.5 mm, the tips being substantially tangential, which were aligned regularly along their diagonals, the large diagonal being arranged in the lengthwise direction of the strip. The strip engraved in this way was about 0.15 mm thick overall. It was then preheated to 200°C and thereafter coated with a non-corrosive flux based on potassium fluoaluminate by spraying an aqueous suspension of flux and drying it continuously.

A check was made to ensure that any discrepancy between the quantity of adherent flux in the cavities on each face was only slight, being of the order of a few percent. The blanks were cut in this strip.

Brazing was carried out in a known manner by induction heating to a temperature of about 600°C.

Conventional wrenching and thermal impact tests were carried out and confirmed that the assembly produced in this way was of an exceptionally high quality.

CLAIMS

1. A process for brazing a metal or metals with flux, wherein a thin strip of solder is engraved on at least one of its faces so as to reveal small cavities adapted to receive the flux, and wherein the metal or metals are brazed using the strip of solder containing the flux.

2. A process according to claim 1, wherein small cavities engraved on a first face of the strip of solder form on the opposite face reliefs leaving between them cavities having a capacity to be filled by the flux which is substantially equal to the capacity of the cavities on the first face.

3. A process according to claim 1 or 2, wherein the contours of the small cavities are regular, rhombus or square quadrilaterals which are aligned along their diagonal and are substantially tangential through their tips, or isosceles or equilateral triangles.

4. A process according to claim 3, wherein the diagonals and the sides of the triangles are between 0.5 and 5 mm.

5. A process according to any of claims 1 to 4, wherein the small cavities are formed by passing the strip of solder between a driven engraving roller and a wild roller covered with a flexible and elastic

6. A process according to any one of claims 1 to 4, wherein the small cavities are shaped by passage between two engraving rollers which are driven synchronously without the possibility of sliding the engravings on one of the rollers being offset by half a step longitudinally and transversely relative to the engravings on the other roller.

7. A process according to any one of claims 1 to 4, wherein the small cavities are shaped by chemical attack of the strip of solder.

8. A process according to any one of claims 1 to 7, wherein the engraved roller is covered with flux before cutting the blanks.

9. A process according to any one of claims 1 to 7, wherein the blanks are cut in the engraved strip and then covered with flux.

10. A process according to any one of claims 1 to 9, wherein the flux is non-corrosive relative to the various elements which are brazed.

11. A process acccording to any one of claims 1 to 10, wherein the metal or metals to be brazed comprise the composite bottom of a kitchen utensil.

12. A process according to claim 1 substantially as herein described with reference to the specific Example.

13. An article comprising metal or metals brazed by a process according to any of claims 1 to 12.

14. A kitchen utensil having a composite bottom comprising brazed metal or metals according to any of claims 1 to 12.

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